Cambridge Assessment International Education

Teacher Pack

Using a Secchi disc

Cambridge IGCSE®

Marine Science 0697

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Cambridge Pathway

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Introduction

This pack will help you to develop your learners' practical skills as defined by assessment objective C (AOC Practical skills and investigations) in the course syllabus.

Important note
Our *Teacher Packs* have been written by **classroom teachers** to help you deliver topics and skills that can be challenging, particularly those that have been indicated as practical activities (PA) in the syllabus content. Use these materials to supplement your teaching and engage your learners. You can also use them to help you create lesson plans for other experiments.

This content is designed to give you and your learners the chance to explore practical skills. It is not intended as specific practice for Paper 2.

This is one of a range of *Teacher Packs* and each pack is based on one investigation. The packs can be used in any order to suit your teaching sequence.

The structure is as follows:

Fieldwork / Lab lesson (1 hour*)	
Option 1 – carry out the investigation	**Option 2 – virtual experiment**
This lesson allows the investigation to be carried out with your learners, providing an opportunity to practise the experimental skills.	This lesson allows your learners to complete a virtual experiment, providing an opportunity to practise the experimental skills when field and lab work are not possible..

Debriefing lesson (1 hour*)
This lesson consolidates and builds on the progress learners have made. Learners evaluation the method and the results they obtained and suggest improvements to the method. Learners research the causes of variation in light penetration in different marine ecosystems and the importance of this to organisms that live there. This will also provide the opportunity to practise extended writing or presentation skills.

** the timings are a guide only; you may need to adapt the lessons to suit your circumstances.*

In this pack you will find lesson plans, worksheets for learners and teacher resource sheets.

Experiment: Using a Secchi disc

This *Teacher Pack* focuses on an investigation into light penetration using a Secchi disc.

A Secchi disc is a black and white coloured disc attached to a line with measurements to record the depth of the disc in the water. The disc can be lowered into the water until the disc is no longer visible to record the depth that light can penetrate to.

This experiment has links to the following syllabus content (see syllabus for detail):

- 2.5.1 State conditions that change with depth (a) light penetration
- 2.5.2 describe how light penetration changes with depth
- 2.5.3 Investigate light penetration through water using a Secchi disc

The experiment covers the following experimental skills, adapted from **AOC: Practical skills and investigations** (see syllabus for assessment objectives):

- demonstrate knowledge of experimental techniques, apparatus and materials and how to use them safely.
- make and record observations, measurements and estimates.
- interpret and evaluate experimental observations and data.

Going forward

The knowledge and skills gained from this experiment can be used for when you teach learners about photosynthesis, feeding relationships and marine ecosystems.

Fieldwork lesson: Option 1 – carry out the investigation

Resources	• Access to a large, deep body of water (i.e. you can't see the bottom) • Secchi discs attached to measuring lines • Worksheet A • Worksheet B
Learning objectives	By the end of the lesson: • ***all*** learners should carry out at least one pair of readings for one depth measurement • ***most*** learners should be able to carry out repeat measurements for one location, or one reading at each of several locations • ***some*** learners will be able to carry out repeat measurements at several locations.

Timings	Activity
10 min	**Starter/Introduction** Show learners the Secchi disc and explain the process of lowering, recording depth as the disc 'just' disappears, then lowering further and slowly raising to record the depth as the disc 'just' reappears. Discuss the safety precautions with the learners, asking learners to repeat back important points and identify an appropriate escape point from the water that they should swim towards if they fall in.
40 min	**Main lesson** **Safety** Circulate among learners during the whole time, watching for any potential hazards. Ensure learners work in a minimum of groups of 2 so that no one is at risk of falling in without being seen. Have flotation aid(s) to hand in case of an accident as well as a first aider and a means of contacting emergency services. Learners carry out the investigation to record light penetration depths at different points in the body of water where appropriate. Use Worksheet A to provide instructions. Handout copies of Worksheet B to help learners record their results (**Extension** – for more advanced learners you might want to suggest that they design their own results table, and then you can give them Worksheet B to compare against). Learners calculate the means for each pair of measurements.
10 min	**Plenary** Learners share and compare their results with each other. Encourage learners to suggest reasons for differences in depth measurements at the same locations – learners should appreciate that using human sight to make measurements is judgement measurement, and this will vary from one person to another.

	Learners could suggest alternative methods to measure light penetration, instead of using Secchi disc, to evaluate and suggest improvements on the method. One improvement could be the use of a waterproof digital light meter, lowered to different depths and recording the intensity of light measured at each depth.

Teacher notes

Watch the Secchi disc video and read these notes.

Each group will require:
- Access to a large, deep body of water (i.e. so you can't see the bottom)
- A Secchi disc attached to a measuring line

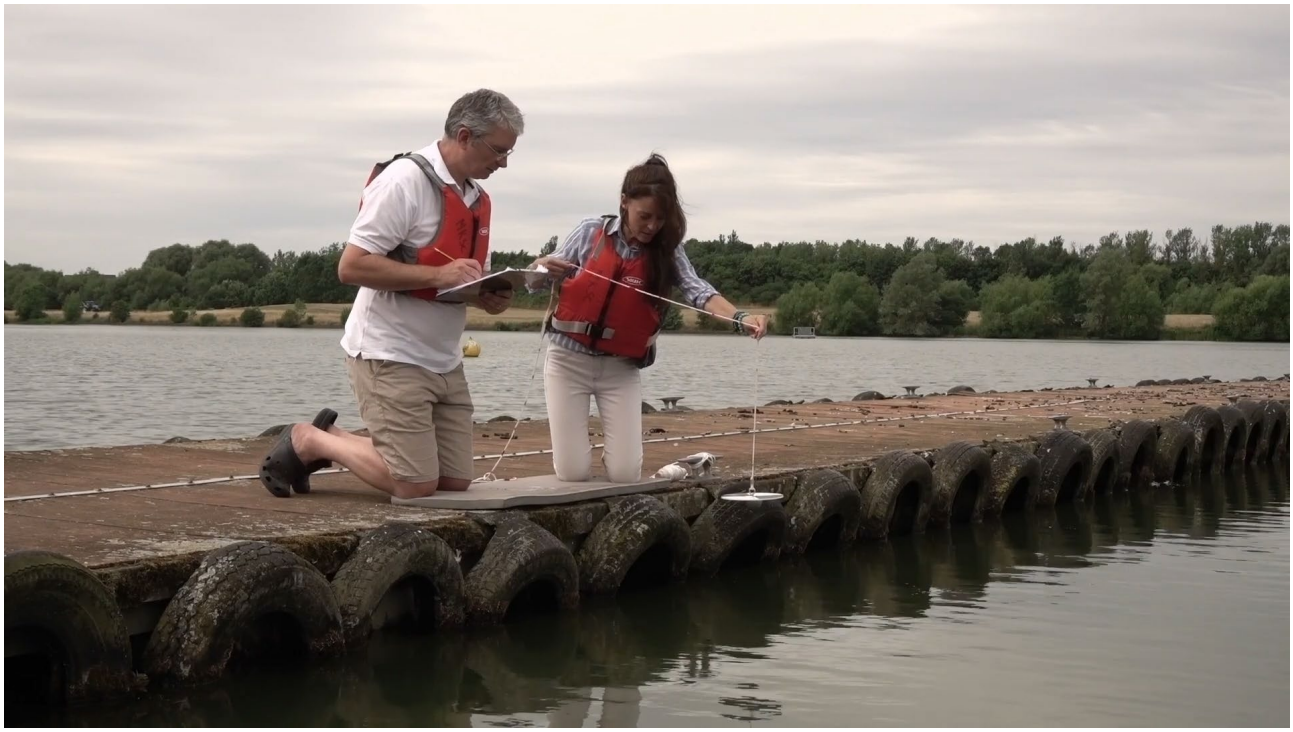
Safety

The information in the table below is a summary of the key points you should consider before undertaking this experiment with your learners.

It is your responsibility to carry out an appropriate risk assessment for this experiment.

Hazard	Steps to reduce risk
Learners falling in the water	Check the areas where learners will be standing are secure (not at a significant risk of slipping in the water). Check there is an appropriate exit-point from the water that learners can use to climb out from unaided. Observe water movement in locations sampled – avoid areas where strong currents may move learners away from the shore or boat. Learners should avoid over-reaching. Have flotation aids and ropes available to help learners stay afloat and get to shore if they do fall in. Consider the use of flotation vests for learners unable to swim in case they fall in the water.
Harmful pathogens or pollution in water	Check for any cuts or grazes on hands and use gloves / waterproof plasters to cover these. Learners avoid touching face or mouth during the investigation and wash hands after completing investigation.

Experiment set-up



Teacher method

This is your version of the method for this experiment that accompanies the video.

Do not share this method with learners. Give them Worksheet A.

Secchi discs can be purchased. Alternatively you can make your own from materials that will sink in the water such as a large metal lid, painted black and white as shown. For the line choose a material that will not easily stretch.

Before you begin

Plan how you will group your learners during the experiment session.

Think about:

- the number of groups you will need (group size 2–4 learners) – do not allow learners to work alone due to the safety risk of falling in unseen.
- the amount of equipment required.
- the number of appropriate locations to sample and the amount of space at each location for separate groups to test.

Experiment

Walk around the learners during the experiment in case they encounter any difficulties and to monitor for any safety problems.

Step	Notes
Lowering and raising the disc	Learners may raise and lower the disc too quickly, resulting in significant differences between the disappearing and reappearing depths. Encourage learners to repeat the measurements more slowly.
Recording the results	Due to wave action a precision of 5 cm or 10 cm is likely to be a reasonable interval of measurement to use. Any movement in the water will disturb the surface and cause inaccuracy in measurements. It is also likely that readings are being taken from a distance so more precise readings may be very difficult to obtain.

Clean-up

After the experiment learners should:

- check they have taken all their belongings with them.
- return all equipment to you.
- washed their hands after returning the equipment.

Lab lesson: Option 2 – virtual investigation

Resources	• *Virtual experiment video* • Worksheet A • Worksheet B • Worksheet B answers
Learning objectives	By the end of the lesson: • ***all*** learners should record pairs of depth readings for difference locations • ***most*** learners should be able to calculate the mean depth for each pair of readings • ***some*** learners will be able to calculate means from repeated measurements at each location

Timings	Activity
10 min	**Starter/Introduction** Show learners the Secchi disc and explain the process of lowering, recording depth the disc 'just' disappears, then lowering further and slowly raising to record the depth the disc 'just' reappears. Share Worksheet A with learners which sets out the method. Discuss the safety precautions for a real investigation with the learners so they are aware of risks involved and how to reduce these risks.
40 min	**Main lesson** Run the video and ask learners to record results of light penetration depths at different points in the body of water, and repeat measurements. Learners use Worksheet B to record the measurements given in the video (**Extension** – more advanced learners might want to produce their own table of results. Share Worksheet B with them to compare after they have done this). Learners calculate the means for each pair of measurements. Learners compare their results to those shown on Worksheet B answers. Discuss potential reasons for differences in light penetration at different locations, or at different times of the year (the video commentary provides some possibilities at the end).
10 min	**Plenary** Encourage learners to suggest reasons for differences in depth measurements at the same locations – learners should appreciate the using human sight to make measurements is judgement measurement and this will vary from one person to another.

	Learners could suggest alternative methods to measure light penetration instead of using Secchi disc to evaluate and suggest improvements on the method. One improvement could be the use of a waterproof digital light meter lowered to different depths and recording the intensity of light measured at each depth.

Debriefing lesson: Evaluation

Resources	• Worksheet A
Learning objectives	By the end of the lesson: • ***all*** learners should suggest improvements to the method or a reason why light penetration may vary • ***most*** learners should be able to suggest improvements to the method **and** a reason why light penetration may vary • ***some*** learners will be able to evaluation the method and results obtained, and provide several reasons why light penetration varies

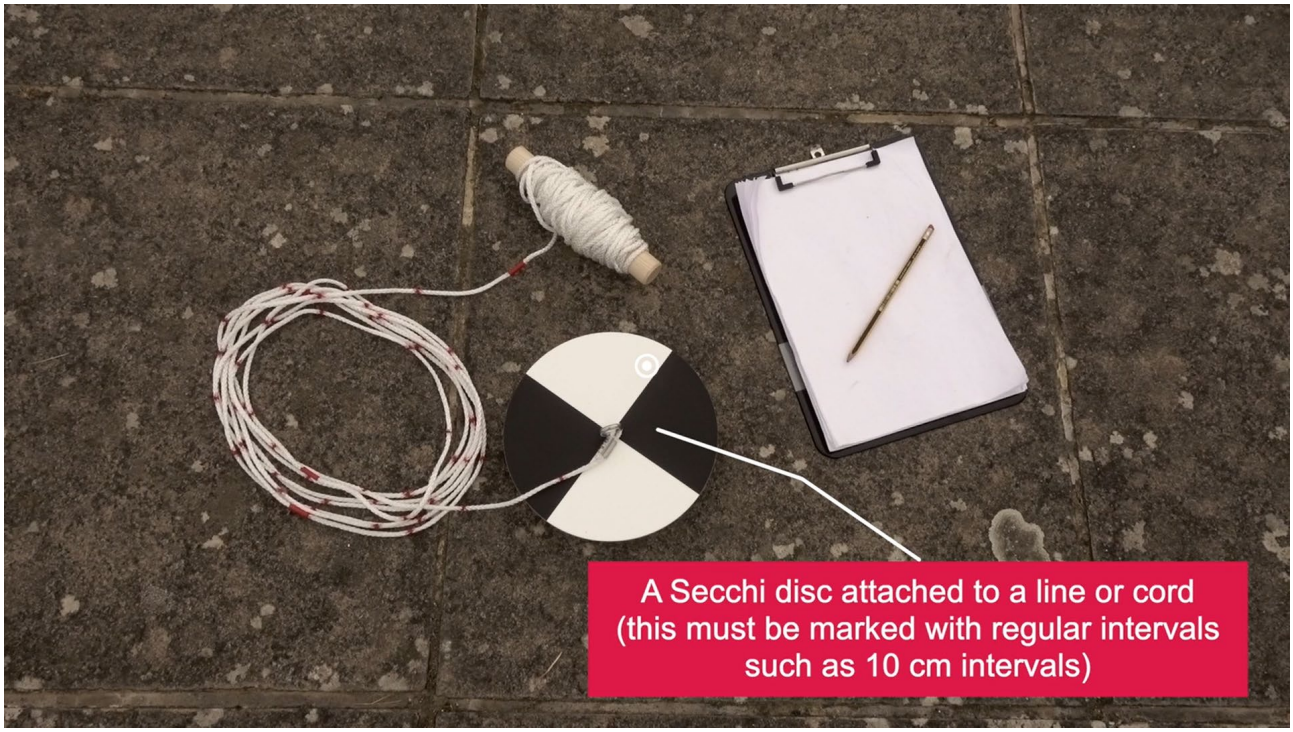
Timings	Activity
10 min	**Starter/Introduction** Recap on the method and discuss any difficulties experienced. Ask learners to suggest possible improvements. You may want to share the method in Worksheet A with learners again to remind them what they did. Discuss reasons for light penetration varying with depth, and why these results may vary in different locations or at different times of the year.
40 min	**Main lesson** Learners evaluate the method of using a Secchi disc and the results they obtained. They could research alternative methods of investigating light penetration such as using a light meter, and propose a more accurate and reliable method to use instead. Learners research light penetration in different types of ecosystem such as coral reefs, mangrove forests and estuaries, and consider reasons for these differences and the impact of these differences on organisms that live there. Learners could summarise their findings in a written report or presentation.
10 min	**Plenary** Learners share their findings with the group.

Worksheets and answers

	Worksheets	Answers
For use in *Fieldwork lesson: Option 1:*		
A: Method	**15**	
B: Results	**16**	**17**
For use in *Lab lesson: Option 2:*		
A: Method	**15**	
B: Results	**16**	**17**

Worksheet A: Method

A Secchi disc is a weighted round disc with four black and white quarters as shown in the figure below.



Choose a location where you will measure the depth of light penetration.

Follow all safety instructions given by your teacher.

1. Lower the Secchi disc into the water until the disc just disappears.
2. Record the depth of the disc in a results table.
3. Continue to lower the disc approximately 1 m further.
4. Slowly raise the disc until you can just see the disc.
5. Record the depth of the disc in your results table.
6. Calculate the mean of the two readings to identify the depth the light penetrates to.
7. Repeat steps 1-6 two more times.
8. Calculate a mean of the three results to determine the final value.

Repeat this process at different locations to compare the light penetration depth.

Look over your observations and data from the experiment and start to evaluate your findings.

Worksheet B: Results

Location	Trial 1			Trial 2			Trial 3			Mean depth / cm
	depth (down) / cm	depth (up) / cm	mean depth / cm	depth (down) / cm	depth (up) / cm	mean depth / cm	depth (down) / cm	depth (up) / cm	mean depth / cm	

Worksheet B: Results (answers)

Location	Trial 1			Trial 2			Trial 3			Mean depth / cm
	depth (down) / cm	depth (up) / cm	mean depth / cm	depth (down) / cm	depth (up) / cm	mean depth / cm	depth (down) / cm	depth (up) / cm	mean depth / cm	
Pontoon	95	100	97.5	100	100	100	100	105	102.5	100
Bay	105	100	102.5	105	110	107.5	105	105	105	105
Island	100	100	100	100	105	102.5	105	105	105	102.5
Bridge	95	95	95	100	95	97.5	95	95	95	95.8
Middle	90	85	87.5	85	85	85	85	90	87.5	86.7

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